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How Safe is Dimethyl Sulfoxide (DMSO): Why We Ditched DMSO

By [Burst Biologics](#) | August 15th, 2017 | [Bio101, Research](#)



The DMSO Double-Edged Sword

At Burst Biologics, we see a lot of double-edged swords throughout science and medicine. Medicine can treat all kinds of conditions but has potential side effects. Surgery carries the risk of complications, even if it means a new lease on life. Ultimately, it's hard to get the good without a risk of the bad.

That's probably why it's widely accepted that the cryoprotective agent (CPA) known as dimethyl sulfoxide (DMSO) is a necessary evil for cryopreserving graft tissue before implantation into patients.

A Brief History of DMSO

Dimethyl sulfoxide is a colorless liquid discovered in 19th century Germany as a byproduct of wood pulp when producing paper. One of its most notable properties is its ability to permeate across cell membranes. This quickly proved useful for dermatological conditions like skin inflammation, or **scleroderma**.

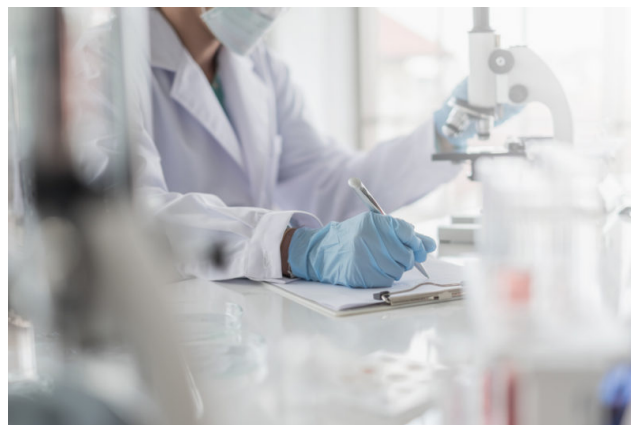
The year 1959 marked the first trial of DMSO usage to prevent freezing damage to living cells. In 1978, DMSO received FDA approval for treating interstitial cystitis, known as chronic bladder pain.

However, all these decades later, the chemical is *still* only approved by the FDA for a single function. There have been rumblings about DMSO's possible use in cancer treatment as well, but according to the Memorial Sloan Kettering Cancer Center, there are still lingering **concerns over potential toxicities** in DMSO. These concerns should, and do, spill over into DMSO's use as a cryoprotectant.

Cell Preserver or Cell Killer

On the positive side, DMSO can permeate across cell membranes, allowing it to inhibit intracellular ice formation. It's also soluble in both aqueous and organic media, meaning it's extremely useful both in the lab and in clinical applications.

But even with all these great properties, DMSO has its drawbacks. The chemical is associated with possible toxicity and a



range of serious side effects. Also, prolonged exposure to dimethyl sulfoxide directly impacts cellular function and growth.

One of our molecular biologists explained that she has used DMSO to preserve cell lines for research, but gets rid of the DMSO as soon as possible. She's learned from experience how quickly it kills her research cells. The same effect can occur in a clinical setting. Once cells begin to thaw, they are susceptible to the cytotoxic effects of dimethyl sulfoxide. With that in mind, how exactly does this chemical affect patients in the real world?

Adverse Reactions from DMSO

As common as DMSO is a cryoprotectant agent, there's still a significant number of potential side effects and adverse reactions associated with the chemical. That's why we made it a priority to **eliminate DMSO** from our products.

Here's a brief look at the many adverse reactions (ARs) recorded after transplantation of hematopoietic stem cells in patients, as compiled in **a study** by Z Shu, S Heimfeld, and D Gao.

Types of Adverse Reactions from DMSO

- **Allergy** — DMSO can induce a release of histamine. Common allergic reactions include flushing, rash, and edema.
- **Gastrointestinal** — Affecting the limbic-hypothalamic pathways, DMSO can result in symptoms like nausea, abdominal pain, and emesis.
- **Renal** — The incidence of kidney-related ARs is comparatively low but includes symptoms like hemoglobinuria, proteinuria, and urine incontinence.
- **Cardiovascular** — Symptoms include hypertension, arrhythmias, tachycardia, shock, cardiac arrest, and seizure.

- **Neurological** — Symptoms include bilateral thalamic infarction, blurred vision, severe encephalopathy, cognition, muscle weakness, and numbness.
- **Hepatic** — Symptoms include progressive jaundice.

As serious as these conditions are, this is only a *partial* list of the identified ARs related to DMSO, based on **many studies centered around the physiological role of the chemical in ARs**, from neurotoxic reactions to shock.

Studies also show that the adverse effects are cumulative. Patients receiving multi-dose therapies containing DMSO may suffer progressively more severe symptoms over time.

Even more worrisome, the scientific community doesn't have a lot of data to suggest what effects the chemical may have on patients long-term. That's why it's problematic to inject people with the chemical – in the long run, we have no idea what may happen.

Now, to be fair, not all adverse reactions (ARs) are solely attributable to DMSO itself. In any allograft or stem cell transplantation procedure, there are many components involved. Some of these factors, such as dead cell debris after thaw or the low temperature of infused products, can also lead to ARs.

But much of the concern *does* lie with DMSO itself, as illuminated by a **documented causal relationship between DMSO and adverse reactions**. That's why there's been a concerted effort in the industry to remove or reduce DMSO from cryopreserved products.

What to do about DMSO

If we know that DMSO has the potential to be harmful to patients, the next question is, what do we do with that information? After all, cryopreservation is still a necessity if we want patients to enjoy the benefits of allografts and tissue supplementation.

Here are four other widely discussed strategies for minimizing adverse reactions to dimethyl sulfoxide in cryopreserved grafts:

- Reducing overall DMSO concentration
- Administering medication before and after transplantation
- Optimizing the infusion procedure
- Using alternative CPAs for cryopreservation

The first three solutions hold some promise, but the bottom line is, nothing is safer than simply avoiding DMSO altogether.

A True DMSO Alternative

At Burst Biologics, we chose the fourth option: adopting a non-toxic DMSO alternative for cryopreservation in our BioBurst fluid allograft products. We developed a patent-pending process to preserve product integrity and address the potentially harmful agent of DMSO in our cryopreservation media.

Our internal team has demonstrated the efficacy of this DMSO-free cryopreservation medium, which enlists USP grade non-toxic ingredients. Ultimately, the products do their job well without even a hint of dimethyl sulfoxide.

In finding a quality DMSO alternative for our BioBurst products, Burst Biologics has taken a major step forward in improving product safety. While there's still work to do, we're proud to be moving forward on innovative new solutions that help people live healthier, more fulfilling lives.

Learn more about our commitment to being DMSO-free.

DISCOVER

Sources:

1. Hematopoietic SCT with cryopreserved grafts: adverse reactions after transplantation and cryoprotectant removal before infusion
2. **Dimethyl Sulfoxide-Induced Toxicity in Cord Blood Stem Cell Transplantation: Report of Three Cases and Review of the Literature**
3. **Clinical Toxicity of Cryopreserved Bone Marrow Graft Infusion**